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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/681,571	05/01/2001	Manoj Ramprasad Shah	RD-28623	6751

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GENERAL ELECTRIC COMPANY
GLOBAL RESEARCH
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EXAMINER	
SHARON, AYAL I	

ART UNIT	PAPER NUMBER
2123	

DATE MAILED: 03/22/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/681,571	Applicant(s) SHAH ET AL.	
	Examiner Ayal I Sharon	Art Unit 2123	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *03 January 2005*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-17* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-17* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *01 May 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Introduction

1. Claims 1-17 of U.S. Application 09/681,571, originally filed on 05/01/2001 are presented for examination. The title and claims 1-11 and 13-17 have been amended in the amendment filed on 1/3/2005.

Claim Interpretations

2. Examiner interprets the following terms according to their definitions in The IEEE Standard Dictionary of Electrical and Electronics Terms, 6th Ed. (1996), as follows:
   a. "Flange" – synonymous with "coupling flange" (IEEE, p.230, and p.415), "The disc-shaped element of a half coupling that permits attachment to a mating half coupling."
   b. "Keybar" – synonymous with "key", definition 2 – rotating machinery (IEEE, p.566), "A bar that by being recessed partly in each of two adjacent members serves to transmit a force from one to the other."
   c. "Phase Belt" - (IEEE, p.765), "A group of adjacent coils in a distributed polyphase winding of an alternating-current machine that are ordinarily connected in series to form one section of a phase winding of the machine. Usually, there are as many such phase belts per phase as there

are poles in the machine. Note: The adjacent coils of a phase belt do not necessarily occupy adjacent slots … "

d. "Rotor" - definition 2 – rotating machinery (IEEE, p.936), "The rotating member of a machine, with shaft. Note: In a direct-current machine with stationary field poles, universal, alternating –current series, and repulsion-type motors, it is called the armature."

e. "Stator" – definition 2 – rotating machinery (IEEE, p.1044), "The portion that includes and supports the stationary active parts. The stator includes the stationary parts of the magnetic circuit and the associated winding and leads. It may, depending on the design, include a frame or shell, winding supports, ventilation circuits, coolers, and temperature detectors. A base, if provided, is not ordinarily considered to be part of the stator.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

4. Claims 1-17 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

The claims refer to "determining electromagnetic effects", however, the extent of enablement in the specification (paragraph 13) consists of the sentence:

> "In embodiments wherein computer simulation is selected, advanced analytical methods such as time stepping finite elements with rotation permit a designer to quantitatively determine the subtle effects of relative locations of the keybars with respect to the phase belts on keybar voltages for a given load."

Examiner finds that the phrase "... advanced analytical methods such as ..." is not enabling because it would require undue experimentation on the part of one of ordinary skill in the art what analytical methods fall into the category of "advanced".

Moreover, Examiner finds that that the phrase "... time stepping finite elements with rotation ..." is not sufficient to enable one of ordinary skill in the art to implement a computer simulation of electromechanical effects without also requiring undue experimentation on the part of one of ordinary skill in the art.

MPEP §2106 (V)(B)(2) states the following:

> In many instances, an applicant will describe a programmed computer by outlining the significant elements of the programmed computer using a functional block diagram. Office personnel should review the specification to ensure that along with the functional block diagram the disclosure provides information that adequately describes each "element" in hardware or hardware and its associated software and how such elements are interrelated. See *In re Scarbrough*, 500 F.2d 560, 565, 182 USPQ 298, 301-02 (CCPA 1974) ("It is not enough that a person skilled in the art, by carrying on investigations along the line indicated in the instant application, and by a great amount of work eventually might find out how to make and use the instant invention. The statute requires the application itself to inform, not to direct others to find out for themselves (citation omitted)."); *Knowlton*, 481 F.2d at 1367, 178 USPQ at 493 (***disclosure must constitute more than a "sketchy explanation of flow diagrams***

> ***or a bare group of program listings together with a reference to a proprietary computer on which they might be run***"). See also *In re Gunn*, 537 F.2d 1123, 1127-28, 190 USPQ 402, 405 (CCPA 1976); *In re Brandstadter*, 484 F.2d 1395, 1406-07, 179 USPQ 286, 294 (CCPA 1973); and *In re Ghiron*, 442 F.2d 985, 991, 169 USPQ 723, 727-28 (CCPA 1971).

However, in the present application, not even a "sketchy explanation of flow diagrams" has been presented for the claimed "determining electromagnetic effects". No equations or algorithms have been presented.

5. Claims 1-17 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

   The claims refer to "determining electromagnetic effects", however, other than the following paragraph in the specification (paragraph 13), there is no other written description of this functionality:

   > "In embodiments wherein computer simulation is selected, advanced analytical methods such as time stepping finite elements with rotation permit a designer to quantitatively determine the subtle effects of relative locations of the keybars with respect to the phase belts on keybar voltages for a given load."

6. In response to these rejections (originally presented in the previous Office Action), the Applicants responded with the following admission on page 8 of the amendment filed on 1/03/2005:

   > With respect to enablement, Applicant respectfully traverses the page 4, section 5, last half of page statement that "advanced analytical methods" and "time stepping finite elements with rotation" mean that one of ordinary

> skill in the art would require too much experimentation. Applicant respectfully submits that commercially available products are available and were available at the time of filing. Three commercial vendor packages include, for example, Maxwell™ simulation from Ansoft Corp. ..., Flux3D simulation software available from Magsoft ..., and MagNet simulation software available from Infolytica Corp.

While constituting an admission of prior art, this statement is not sufficient for withdrawing the 35 USC §112 rejections, because the admission of prior art is not sufficiently detailed as to enable one of ordinary skill in the art at the time the invention was made would make and/or use the claimed invention from the commercially available software packages.

7. The specification regarding the claimed invention is deficient in the areas cited above. Accordingly, the examiner has made prior art rejections based on the limited scope of information contained in the specification for supporting the claims. The rejections are complete and specifically applied against the claims based on this limited disclosure.

Claim Rejections - 35 USC § 102

8. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

9. The prior art used for these rejections is as follows:

10. Applicants' own admission in page 8 of the amendment filed on 1/03/2005.

11. Claims 1-17 are rejected under 35 U.S.C. 102(b) as being anticipated by Applicants' own admission.

12. The Applicants have presented the following admission on page 8 of the amendment filed on 1/03/2005:

> With respect to enablement, Applicant respectfully traverses the page 4, section 5, last half of page statement that "advanced analytical methods" and "time stepping finite elements with rotation" mean that one of ordinary skill in the art would require too much experimentation. Applicant respectfully submits that commercially available products are available and were available at the time of filing. Three commercial vendor packages include, for example, Maxwell™ simulation from Ansoft Corp. ..., Flux3D simulation software available from Magsoft ..., and MagNet simulation software available from Infolytica Corp.

The applicant has therefore admitted that commercially available products at the time the application was filed enabled the claimed invention, and therefore the claimed invention is not novel.

Claim Rejections - 35 USC § 103

13. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

14. The prior art used for these rejections is as follows:

15. Perkins, K. et al. "Special Problems in the Installation of Large Electrical Machines", Power Engineering Journal, Jan. 1992. Vol.6, Issue 1, pp.21-31. (Henceforth referred to as "**Perkins**").

16. Gieras, J. et al., "Calculation of Synchronous Reactances of Small Permanent-Magnet Alternating-Current Motors: Comparison of Analytical Approach and Finite Element Method with Measurements." IEEE Transactions on Magnetics, Sept., 1998, Vol.34, No.5, pp.3712-3720. (Henceforth referred to as "**Gieras**").

17. The claim rejections are hereby summarized for Applicant's convenience. The detailed rejections follow.

18. **Claims 1-3, 5, 7-9, and 11-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Perkins in view of Gieras.**

19. In regards to Claim 1,

> 1. A method for designing a stator for an electric machine comprising lamination segments coupled to a stator frame by keybars and stator winding phase belts within stator slots of the lamination segments, the method comprising:
>
> determining effects on at least one of keybar voltage or keybar current of adjusting positions of the keybars with respect to positions of the phase belts; and
>
> selecting a position of the keybars with respect to a position of the phase belts which provides minimal keybar voltage.

Perkins teaches (see p.23, "Stator Building", right column, paragraphs 2-3):

> The laminations are held in position by dovetails in their outer periphery, which are threaded over 45 keybars. These keybars are welded to the stator frame sections as the core building proceeds. The welding is very specialized, since by varying the sequence of welds it is possible to correct any incipient distortion and drift from the required diametric and vertical accuracy, as monitored by high-precision gagues. ...
>
> The fitting clearance of the dovetails makes it necessary to adjust each punching as it is fitted, and it is vitally important that punchings bed down tightly against each other at the key bars; if not a completed core would not meet its design performance, and could become loose in service.

Perkins also teaches (see p.28, "Testing", right column):

> All testing that would normally be carried out in the factory had to be performed at site, and this included the electromagnetic testing of stator cores as well as high-voltage testing of stator bars on a daily basis as they were installed.

Perkins, however, does not expressly teach the use of "phase belts" or "number of stator slots."

Gieras teaches, in regards to phase belts, that (See p.3715, "B.Synchronous Reactances", para.1):

> the d-axis and q-axis fluxes are obtained from the combination of the phase-belt linkages [3], [4], [6], [18]. According to the phasor diagram for a synchronous motor, the rotor excitation flux and d-axis armature flux are in the same direction while the q-axis armature flux is perpendicular.

Gieras also teaches, in regards to stator slots, that (See p.3712, "II.Analytical Approach", para.1):

> The leakage reactance X1 consists of the slot, differential, tooth-top, and end-connection leakage reactances. Only the slot and differential leakage reactances depend on the magnetic saturation due to leakage fields. It can be taken into account using Norman's method [16]."

It is inherent that larger the number of slots, the larger the leakage reactance.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the teachings of Perkins with those of Gieras because doing so would enable a comparison of modeled and empirical results (see Gieras, Abstract):

> Synchronous reactances as functions of the stator current and load angle obtained analytically from the FEM modeling and measurements have been compared

In addition, Gieras teaches that (See p.3712, "I.Introduction", para.2):

> The finite element method (FEM) makes it possible to find the d- and q-axis synchronous reactances and mutual (armature reaction) reactances by computing the corresponding inductances.... Recently, two modern FEM techniques in ac machines have emerged: *current/energy pertubation method* [7], [8], [15], [23] and *time-stepping analysis* [1], [5]. These methods are especially suitable for transient analysis of converter-fed PM synchronous machines.

20. In regards to Claim 2,

> 2. The method of claim 1 further comprising determining effects of adjusting the number of keybars, and wherein selecting the position of the keybars comprises selecting both the position of the keybars and a number of the keybars to provide minimal keybar voltage.

Perkins teaches (see p.23, "Stator Building", right column, paragraphs 2-3):

> The laminations are held in position by dovetails in their outer periphery, which are threaded over 45 keybars. These keybars are welded to the stator frame sections as the core building proceeds. The welding is very specialized, since by varying the sequence of welds it is possible to correct any incipient distortion and drift from the required diametric and vertical accuracy, as monitored by high-precision gagues. ...
>
> The fitting clearance of the dovetails makes it necessary to adjust each punching as it is fitted, and it is vitally important that punchings bed down tightly against each other at the key bars; if not a completed core would not meet its design performance, and could become loose in service.

Perkins also teaches (see p.28, "Testing", right column):

> All testing that would normally be carried out in the factory had to be performed at site, and this included the electromagnetic testing of stator cores as well as high-voltage testing of stator bars on a daily basis as they were installed.

Perkins, however, does not expressly teach the use of "phase belts" or "number of stator slots."

Gieras teaches, in regards to phase belts, that (See p.3715, "B.Synchronous Reactances", para.1):

> the d-axis and q-axis fluxes are obtained from the combination of the phase-belt linkages [3], [4], [6], [18]. According to the phasor diagram for a synchronous motor, the rotor excitation flux and d-axis armature flux are in the same direction while the q-axis armature flux is perpendicular.

Gieras also teaches, in regards to stator slots, that (See p.3712, "II.Analytical Approach", para.1):

> The leakage reactance X1 consists of the slot, differential, tooth-top, and end-connection leakage reactances. Only the slot and differential leakage reactances depend on the magnetic saturation due to leakage fields. It can be taken into account using Norman's method [16]."

It is inherent that larger the number of slots, the larger the leakage reactance.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the teachings of Perkins with those of Gieras because doing so would enable a comparison of modeled and empirical results (see Gieras, Abstract):

> Synchronous reactances as functions of the stator current and load angle obtained analytically from the FEM modeling and measurements have been compared

In addition, Gieras teaches that (See p.3712, "I.Introduction", para.2):

> The finite element method (FEM) makes it possible to find the d- and q-axis synchronous reactances and mutual (armature reaction) reactances by computing the corresponding inductances.... Recently, two modern FEM techniques in ac machines have emerged: *current/energy pertubation method* [7], [8], [15], [23] and *time-stepping analysis* [1], [5]. These methods are especially suitable for transient analysis of converter-fed PM synchronous machines.

21. In regards to Claim 3,

3. The method of claim 1 further comprising <u>determining effects</u>
of adjusting the number of stator slots, and wherein selecting the
position of the keybars comprises selecting both the position of the keybars and

a number of the stator slots to provide minimal keybar voltage.

Perkins teaches (see p.23, "Stator Building", right column, paragraphs 2-3):

> The laminations are held in position by dovetails in their outer periphery, which are threaded over 45 keybars. These keybars are welded to the stator frame sections as the core building proceeds. The welding is very specialized, since by varying the sequence of welds it is possible to correct any incipient distortion and drift from the required diametric and vertical accuracy, as monitored by high-precision gagues. ...
>
> The fitting clearance of the dovetails makes it necessary to adjust each punching as it is fitted, and it is vitally important that punchings bed down tightly against each other at the key bars; if not a completed core would not meet its design performance, and could become loose in service.

Perkins also teaches (see p.28, "Testing", right column):

> All testing that would normally be carried out in the factory had to be performed at site, and this included the electromagnetic testing of stator cores as well as high-voltage testing of stator bars on a daily basis as they were installed.

Perkins, however, does not expressly teach the use of "phase belts" or "number of stator slots."

Gieras teaches, in regards to phase belts, that (See p.3715, "B.Synchronous Reactances", para.1):

> the d-axis and q-axis fluxes are obtained from the combination of the phase-belt linkages [3], [4], [6], [18]. According to the phasor diagram for a synchronous motor, the rotor excitation flux and d-axis armature flux are in the same direction while the q-axis armature flux is perpendicular.

Gieras also teaches, in regards to stator slots, that (See p.3712, "II.Analytical Approach", para.1):

> The leakage reactance X1 consists of the slot, differential, tooth-top, and end-connection leakage reactances. Only the slot and differential leakage reactances depend on the magnetic saturation due to leakage fields. It can be taken into account using Norman's method [16]."

It is inherent that larger the number of slots, the larger the leakage reactance.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the teachings of Perkins with those of Gieras because doing so would enable a comparison of modeled and empirical results (see Gieras, Abstract):

> Synchronous reactances as functions of the stator current and load angle obtained analytically from the FEM modeling and measurements have been compared

In addition, Gieras teaches that (See p.3712, "I.Introduction", para.2):

> The finite element method (FEM) makes it possible to find the d- and q-axis synchronous reactances and mutual (armature reaction) reactances by computing the corresponding inductances.... Recently, two modern FEM techniques in ac machines have emerged: *current/energy pertubation method* [7], [8], [15], [23] and *time-stepping analysis* [1], [5]. These methods are especially suitable for transient analysis of converter-fed PM synchronous machines.

22. In regards to Claim 5,

> 5. A method for designing a stator for an electric machine comprising lamination segments coupled to a stator frame by keybars and stator winding phase belts within stator slots of the lamination segments, the method comprising:
>
> determining effects <u>on at least one of keybar voltage or keybar current</u> of adjusting positions of the keybars with respect to positions of the phase belts, adjusting the number of keybars, and adjusting the number of stator slots; and
>
> selecting a position of the keybars with respect to a position of the phase belts, a number of the keybars, and a number of stator slots which collectively provide minimal <u>keybar voltage</u>.

Perkins teaches (see p.23, "Stator Building", right column, paragraphs 2-3):

> The laminations are held in position by dovetails in their outer periphery, which are threaded over 45 keybars. These keybars are welded to the

> stator frame sections as the core building proceeds. The welding is very specialized, since by varying the sequence of welds it is possible to correct any incipient distortion and drift from the required diametric and vertical accuracy, as monitored by high-precision gagues. ...
>
> The fitting clearance of the dovetails makes it necessary to adjust each punching as it is fitted, and it is vitally important that punchings bed down tightly against each other at the key bars; if not a completed core would not meet its design performance, and could become loose in service.

Perkins also teaches (see p.28, "Testing", right column):

> All testing that would normally be carried out in the factory had to be performed at site, and this included the electromagnetic testing of stator cores as well as high-voltage testing of stator bars on a daily basis as they were installed.

Perkins, however, does not expressly teach the use of "phase belts" or "number of stator slots."

Gieras teaches, in regards to phase belts, that (See p.3715, "B.Synchronous Reactances", para.1):

> the d-axis and q-axis fluxes are obtained from the combination of the phase-belt linkages [3], [4], [6], [18]. According to the phasor diagram for a synchronous motor, the rotor excitation flux and d-axis armature flux are in the same direction while the q-axis armature flux is perpendicular.

Gieras also teaches, in regards to stator slots, that (See p.3712, "II.Analytical Approach", para.1):

> The leakage reactance X1 consists of the slot, differential, tooth-top, and end-connection leakage reactances. Only the slot and differential leakage reactances depend on the magnetic saturation due to leakage fields. It can be taken into account using Norman's method [16]."

It is inherent that larger the number of slots, the larger the leakage reactance.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the teachings of Perkins with those of Gieras because doing so would enable a comparison of modeled and empirical results (see Gieras, Abstract):

> Synchronous reactances as functions of the stator current and load angle obtained analytically from the FEM modeling and measurements have been compared

In addition, Gieras teaches that (See p.3712, "I.Introduction", para.2):

> The finite element method (FEM) makes it possible to find the d- and q-axis synchronous reactances and mutual (armature reaction) reactances by computing the corresponding inductances.... Recently, two modern FEM techniques in ac machines have emerged: *current/energy pertubation method* [7], [8], [15], [23] and *time-stepping analysis* [1], [5]. These methods are especially suitable for transient analysis of converter-fed PM synchronous machines.

23. In regards to Claim 7, Perkins teaches the following limitations:

7. A method for designing a stator for an electric machine comprising lamination segments coupled to a stator frame by keybars and stator winding phase belts within stator slots of the lamination segments, the method comprising:

<u>determining effects</u> <u>on at least one of keybar voltage or keybar current</u> of adjusting the number of keybars; and

selecting a number of the keybars which provides minimal <u>keybar voltage</u>.

Perkins teaches (see p.23, "Stator Building", right column, paragraphs 2-3):

> The laminations are held in position by dovetails in their outer periphery, which are threaded over 45 keybars. These keybars are welded to the stator frame sections as the core building proceeds. The welding is very specialized, since by varying the sequence of welds it is possible to correct any incipient distortion and drift from the required diametric and vertical accuracy, as monitored by high-precision gagues. ...
>
> The fitting clearance of the dovetails makes it necessary to adjust each punching as it is fitted, and it is vitally important that punchings bed down

> tightly against each other at the key bars; if not a completed core would not meet its design performance, and could become loose in service.

Perkins also teaches (see p.28, "Testing", right column):

> All testing that would normally be carried out in the factory had to be performed at site, and this included the electromagnetic testing of stator cores as well as high-voltage testing of stator bars on a daily basis as they were installed.

Perkins, however, does not expressly teach the use of "phase belts" or "number of stator slots."

Gieras teaches, in regards to phase belts, that (See p.3715, "B.Synchronous Reactances", para.1):

> the d-axis and q-axis fluxes are obtained from the combination of the phase-belt linkages [3], [4], [6], [18]. According to the phasor diagram for a synchronous motor, the rotor excitation flux and d-axis armature flux are in the same direction while the q-axis armature flux is perpendicular.

Gieras also teaches, in regards to stator slots, that (See p.3712, "II.Analytical Approach", para.1):

> The leakage reactance X1 consists of the slot, differential, tooth-top, and end-connection leakage reactances. Only the slot and differential leakage reactances depend on the magnetic saturation due to leakage fields. It can be taken into account using Norman's method [16]."

It is inherent that larger the number of slots, the larger the leakage reactance.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the teachings of Perkins with those of Gieras because doing so would enable a comparison of modeled and empirical results (see Gieras, Abstract):

> Synchronous reactances as functions of the stator current and load angle obtained analytically from the FEM modeling and measurements have been compared

In addition, Gieras teaches that (See p.3712, "I.Introduction", para.2):

> The finite element method (FEM) makes it possible to find the d- and q-axis synchronous reactances and mutual (armature reaction) reactances by computing the corresponding inductances.... Recently, two modern FEM techniques in ac machines have emerged: *current/energy pertubation method* [7], [8], [15], [23] and *time-stepping analysis* [1], [5]. These methods are especially suitable for transient analysis of converter-fed PM synchronous machines.

24. In regards to Claim 8, Perkins teaches the following limitations:

> 8. The method of claim 7 further comprising determining effects of adjusting the number of stator slots, and wherein selecting the number of the keybars comprises selecting both the number of the keybars and a number of the stator slots to provide minimal keybar voltage.

Perkins teaches (see p.23, "Stator Building", right column, paragraphs 2-3):

> The laminations are held in position by dovetails in their outer periphery, which are threaded over 45 keybars. These keybars are welded to the stator frame sections as the core building proceeds. The welding is very specialized, since by varying the sequence of welds it is possible to correct any incipient distortion and drift from the required diametric and vertical accuracy, as monitored by high-precision gagues. ...
>
> The fitting clearance of the dovetails makes it necessary to adjust each punching as it is fitted, and it is vitally important that punchings bed down tightly against each other at the key bars; if not a completed core would not meet its design performance, and could become loose in service.

Perkins also teaches (see p.28, "Testing", right column):

> All testing that would normally be carried out in the factory had to be performed at site, and this included the electromagnetic testing of stator cores as well as high-voltage testing of stator bars on a daily basis as they were installed.

Perkins, however, does not expressly teach the use of "phase belts" or "number of stator slots."

Gieras teaches, in regards to phase belts, that (See p.3715, "B.Synchronous Reactances", para.1):

> the d-axis and q-axis fluxes are obtained from the combination of the phase-belt linkages [3], [4], [6], [18]. According to the phasor diagram for a synchronous motor, the rotor excitation flux and d-axis armature flux are in the same direction while the q-axis armature flux is perpendicular.

Gieras also teaches, in regards to stator slots, that (See p.3712, "II.Analytical Approach", para.1):

> The leakage reactance X1 consists of the slot, differential, tooth-top, and end-connection leakage reactances. Only the slot and differential leakage reactances depend on the magnetic saturation due to leakage fields. It can be taken into account using Norman's method [16]."

It is inherent that larger the number of slots, the larger the leakage reactance.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the teachings of Perkins with those of Gieras because doing so would enable a comparison of modeled and empirical results (see Gieras, Abstract):

> Synchronous reactances as functions of the stator current and load angle obtained analytically from the FEM modeling and measurements have been compared

In addition, Gieras teaches that (See p.3712, "I.Introduction", para.2):

> The finite element method (FEM) makes it possible to find the d- and q-axis synchronous reactances and mutual (armature reaction) reactances by computing the corresponding inductances.... Recently, two modern FEM techniques in ac machines have emerged: *current/energy pertubation method* [7], [8], [15], [23] and *time-stepping analysis* [1], [5]. These methods are especially suitable for transient analysis of converter-fed PM synchronous machines.

25. In regards to Claim 9, Perkins teaches the following limitations:

9. A method for designing a stator for an electric machine comprising lamination segments coupled to a stator frame by keybars and stator winding phase belts within stator slots of the lamination segments, the method comprising:

determining effects on at least one of keybar voltage or keybar current of adjusting the number of stator slots; and

selecting a number of the stator slots which provides minimal keybar voltage.

Perkins teaches (see p.23, "Stator Building", right column, paragraphs 2-3):

> The laminations are held in position by dovetails in their outer periphery, which are threaded over 45 keybars. These keybars are welded to the stator frame sections as the core building proceeds. The welding is very specialized, since by varying the sequence of welds it is possible to correct any incipient distortion and drift from the required diametric and vertical accuracy, as monitored by high-precision gagues. ...
>
> The fitting clearance of the dovetails makes it necessary to adjust each punching as it is fitted, and it is vitally important that punchings bed down tightly against each other at the key bars; if not a completed core would not meet its design performance, and could become loose in service.

Perkins also teaches (see p.28, "Testing", right column):

> All testing that would normally be carried out in the factory had to be performed at site, and this included the electromagnetic testing of stator cores as well as high-voltage testing of stator bars on a daily basis as they were installed.

Perkins, however, does not expressly teach the use of "phase belts" or "number of stator slots."

Gieras teaches, in regards to phase belts, that (See p.3715, "B.Synchronous Reactances", para.1):

> the d-axis and q-axis fluxes are obtained from the combination of the phase-belt linkages [3], [4], [6], [18]. According to the phasor diagram for a synchronous motor, the rotor excitation flux and d-axis armature flux are in the same direction while the q-axis armature flux is perpendicular.

Gieras also teaches, in regards to stator slots, that (See p.3712, "II.Analytical Approach", para.1):

> The leakage reactance X1 consists of the slot, differential, tooth-top, and end-connection leakage reactances. Only the slot and differential leakage reactances depend on the magnetic saturation due to leakage fields. It can be taken into account using Norman's method [16]."

It is inherent that larger the number of slots, the larger the leakage reactance.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the teachings of Perkins with those of Gieras because doing so would enable a comparison of modeled and empirical results (see Gieras, Abstract):

> Synchronous reactances as functions of the stator current and load angle obtained analytically from the FEM modeling and measurements have been compared

In addition, Gieras teaches that (See p.3712, "I.Introduction", para.2):

> The finite element method (FEM) makes it possible to find the d- and q-axis synchronous reactances and mutual (armature reaction) reactances by computing the corresponding inductances.... Recently, two modern FEM techniques in ac machines have emerged: *current/energy pertubation method* [7], [8], [15], [23] and *time-stepping analysis* [1], [5]. These methods are especially suitable for transient analysis of converter-fed PM synchronous machines.

26. **Claim 11 is rejected based on the same reasoning as the rejection of claim 1 that is described in detailed above. Claims 11 is a system claim reciting the equivalent limitations as are recited in method claim 1 and taught throughout Perkins and Gieras.**

27. In regards to Claim 12, Perkins does not expressly teach the use of a computer, as claimed in the following limitations:

12. The system of claim 10 wherein the means for determining and the means for selecting comprise a computer.

Gieras, on the other hand, expressly teaches (see Abstract. Emphasis added) that "Synchronous reactances as functions as functions of the stator current and load angle obtained analytically from the FEM [finite element method] modeling and from measurements have been compared."

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the teachings of Perkins with those of Gieras because doing so would enable a comparison of modeled and empirical results (see Gieras, pp.3718-3719, Section "E.Comparison" and "VI.Conclusion").

28. **Claims 13, 14, 15, and 16 are rejected based on the same reasoning as the rejections of claims 5, 7, 9 and 2 respectively, that are described in detailed above. Claims 13, 14, 15, and 16 are system claims reciting the equivalent limitations as are recited in method claims 5, 7, 9, and 2 and taught throughout Perkins and Gieras.**

29. In regards to Claim 17,

17. A system for designing a stator for an electric machine comprising lamination segments coupled to a stator frame by keybars and stator winding phase belts within stator slots of the lamination segments, the system comprising a computer for performing simulations to <u>determining effects</u> <u>on at least one of keybar voltage or keybar current</u> of adjusting positions of the keybars with respect to positions of the phase belts, adjusting the number of keybars, and adjusting the number of stator slots.

Perkins teaches (see p.23, "Stator Building", right column, paragraphs 2-3):

> The laminations are held in position by dovetails in their outer periphery, which are threaded over 45 keybars. These keybars are welded to the

> stator frame sections as the core building proceeds. The welding is very specialized, since by varying the sequence of welds it is possible to correct any incipient distortion and drift from the required diametric and vertical accuracy, as monitored by high-precision gagues. ...
>
> The fitting clearance of the dovetails makes it necessary to adjust each punching as it is fitted, and it is vitally important that punchings bed down tightly against each other at the key bars; if not a completed core would not meet its design performance, and could become loose in service.

Perkins also teaches (see p.28, "Testing", right column):

> All testing that would normally be carried out in the factory had to be performed at site, and this included the electromagnetic testing of stator cores as well as high-voltage testing of stator bars on a daily basis as they were installed.

Perkins, however, does not expressly teach the use of "a computer for performing simulations."

Gieras, on the other hand, expressly teaches (see Abstract and p.3717. Emphasis added) that "Synchronous reactances as functions as functions of the stator current and load angle obtained analytically from the FEM [finite element method] modeling and from measurements have been compared."

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the teachings of Perkins with those of Gieras because doing so would enable a comparison of modeled and empirical results (see Gieras, Abstract):

> Synchronous reactances as functions of the stator current and load angle obtained analytically from the FEM modeling and measurements have been compared

In addition, Gieras teaches that (See p.3712, "I.Introduction", para.2):

> The finite element method (FEM) makes it possible to find the d- and q-axis synchronous reactances and mutual (armature reaction) reactances by computing the corresponding inductances.... Recently, two modern FEM techniques in ac machines have emerged: *current/energy pertubation method* [7], [8], [15], [23] and *time-stepping analysis* [1], [5]. These methods are especially suitable for transient analysis of converter-fed PM synchronous machines.

Response to Amendment

Re: Claim Interpretations

30. Applicants state (in the amendment filed 1/3/05, p.1) that they do not "fully understand the reason that this Office Action includes a definition section..." Examiner included the definitions in order to ensure that the record is clear as to the Examiner's interpretation of the claim language.

31. More specifically, Examiner was unable to locate any prior art that contained the term "keybar" – a term which appears prominently in the claims. On the other hand, Examiner did locate a definition for "key" in the The IEEE Standard Dictionary of Electrical and Electronics Terms, 6th Ed. (1996), which is defined as "A bar ...". The Examiner therefore finds "key" to be synonymous with the claimed "keybar".

32. Examiner would like to remind the Applicants that the claim language is given the broadest reasonable interpretation consistent with the specification. See *In re Morris*, 127 F.3d 1048, 44 USPQ2d 1023 (Fed. Cir. 1997). See MPEP §904.01 and §2111 - §2116.01 for more details.

33. The Applicants unpersuasively argue (amendment filed 1/3/05, p.7) that:

> Applicant respectfully traverses the Office Action statement on page 2, section 2.b. and submits that a keybar is not synonymous with a "key" definition 2 of the IEEE dictionary (bar that by being recessed partly in each of two adjacent members serves to transmit a force from one to the other). As stated in Applicants' Specification, paragraph 2, keybars are attached to a stator by two flanges for meeting mechanical requirements of the stator. Although there is a "dovetail" or "key" type section of a keybar (as can be seen in Fig.2), this is not synonymous with a standard key of the type referenced in the IEEE dictionary where two angled elements are inserted into opposing ends of an opening to support key type coupling.

Examiner notes that the IEEE dictionary definition makes no reference to "two angled elements." Examiner finds that the IEEE dictionary definition is broad enough to cover the Applicants' claimed "keybars" that are "attached to a stator by two flanges for meeting mechanical requirements of the stator."

34. Moreover, in response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., two flanges, lack of angled elements) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

35. The Applicants persuasively argue (amendment filed 1/3/05, p.7) that:

> Applicant respectfully traverses the Office Action statement on page 3, section 3 and submits that it is incorrect to state that "the keybars are the bars that create the stator casing." Applicant did not specifically reference a "casing" in the specification or claims but does mention that the keybars coupled the stator laminations to a stator frame 40. As is known to those of ordinary skill in the art, this is often accomplished via section plates (large washers), for example, which are welded over the keybars and cylinder, spaced out along the cylinder, and coupled to an outer casing. One textbook with a corresponding photo (with numbers inserted in pencil) of keybar (1), section plate (2), and casing (3) is Leander W. Matsch, Late,

and J. Derald Morgan, Electromagnetic and Electromechanical Machines, 3rd Edition, Harper & Row, page 159 (1988).

36. Examiner has withdrawn the statement that "the keybars are the bars that create the stator casing" from the Claim Interpretations section of this Office Action.

37. Moreover, Examiner notes Applicants' statement on p.7 (emphasis added) that: "Applicant did not specifically reference a "casing" in the specification or claims but does mention that the keybars coupled the stator laminations to a stator frame 40."

Re: Claim Rejections - 35 USC § 112

38. Examiner acknowledges Applicants' amendments to the claims, which include removing "electromagnetic effects" and "specifying more particularly that what is being determined is keybar voltage or keybar current and what is being minimized is keybar voltage." (See amendment, p.7).

39. In response to the enablement and written description rejections, Applicants have provided two arguments (See amendment, p.8, para.1):

    a. Commercially available products were available at the time of filing (e.g., Maxwell™, Flux3D, and Magnet).

    b. Determination (of the voltage and current effects) can be made by physical testing.

40. Examiner interprets Applicants' argument of commercially available products available at the time of filing as being an admission of prior art. New 35 USC §102 rejections based on this admission have been added.

41. However, the 35 USC §112 rejections have not been withdrawn, because the admission of prior art is not sufficiently detailed as to enable one of ordinary skill in the art at the time the invention was made would make and/or use the claimed invention from the commercially available software packages.

42. In addition, Examiner finds Applicants' argument that "... determination [of the voltage and current effects] can be made by physical testing itself" is an indication of the metes and bounds of the claims. The new references applied for the 35 USC § 103 rejections conform to these metes and bounds.

Re: Claim Rejections - 35 USC § 102

43. Regarding the Ito reference, applicants argue (amendment filed 1/3/2005, p.8) that:

> Ito appears to be a description of a mechanical technique directed to moving a resonant frequency fe to 2fe (Ito, Fig.2) for the purpose of reducing stator frame size (abstract).
>
> ... Applicant can find no reference in Ito to determining any keybar voltage effects, keybar current effects, or any type of electromagnetic effect.

44. The Applicants are referred to Ito, p.420, "Introduction", which teaches:

> Functions generally required for stator frames include the following:
>
> ... (iii) Reduction of electromagnetic vibration and noise under normal operation
>
> ... Electromagnetic vibration and noise are caused by the annular vibration of a stator core resulting from the electromagnetic excitation of a rotor in operation. For this reason, regarding 2-pole units, the core is generally supported flexibly in a stator frame while, with the aim of avoiding resonance, annular natural frequency of a stator frame is set at above the electromagnetic double excitation frequency.

45. On the other hand, in light of Applicants' amendments to the independent claims 1, 5, 7, 9-11 and 13-17, which deleted the term "electromagnetic" and replaced it with "at least one of keybar voltage or keybar current", Examiner is withdrawing the rejections based on the Ito reference.

46. New rejections have been applied, as necessitated by Applicants' amendment. The new references applied for the 35 USC §103 rejections conforms to the metes and bounds defined by the Applicants (-in response to the 35 USC §112 rejections – see amendment, p.8, para.1) that include "physical testing" as a form of enablement.

Re: Request for Interview

47. Examiner will be willing to consider an After-Final interview for this case after receiving a detailed agenda in a PTOL-413A form.

Miscellaneous

48. Examiner notes that claims 4, 6, and 10 recite a limitation of "adjusting" or "selecting" a "direction of rotation." Neither Perkins nor Gieras expressly teach this limitation, however, Examiner has not found enablement for this limitation in the specification.

Conclusion

49. Applicants' amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Correspondence Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ayal I. Sharon whose telephone number is (571) 272-3714. The examiner can normally be reached on Monday through Thursday, and the first Friday of a biweek, 8:30 am – 5:30 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kevin Teska can be reached at (571) 272-3716.

Any response to this office action should be faxed to (703) 872-9306, or mailed to:

USPTO
P.O. Box 1450
Alexandria, VA 22313-1450

or hand carried to:

USPTO
Customer Service Window
Randolph Building
401 Dulany Street
Alexandria, VA 22314

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Tech Center 2100 Receptionist, whose telephone number is (571) 272-2100.

Ayal I. Sharon

Art Unit 2123

March 9, 2005

KEVIN J. TESKA
SUPERVISORY
PATENT EXAMINER